

Application No.: 10/520,028  
Amendment Dated: January 25, 2010  
Reply to Office Action of: December 9, 2009

MAT-8645US

**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application.

**Listing of Claims:**

1. (Cancelled)
2. (Previously Presented) A transmitting apparatus for transmitting data to a radio station, the apparatus comprising:
  - an array antenna including M, pieces of antenna elements for receiving a carrier modulation signal of a known symbol that is transmitting from a radio station and for transmitting a signal to the radio station, where M is an integer of 2 or more;
  - a reference symbol generation means for generating a reference symbol that gives a phase reference and is the same symbol with the known symbol;
  - a propagation channel estimation means for generating receiving symbols from a baseband signal received at the antenna elements based on the reference symbol, wherein the receiving symbols are estimate values for a complex propagation channel between a transmitting antenna of the radio station and the array antenna;
  - a transmitting symbol calculation means for calculating plural sets of transmitting symbol vectors from the receiving symbols so that each transmitting symbol vector is configured by plural sets of transmitting symbols and then generating a reference table configured by the plural sets of transmitting symbol vectors;
  - a symbol mapping means for generating transmitting symbols by selecting one set of the transmitting symbol vector from the reference table based on transmitting data;
  - a carrier modulation means for generating baseband signals from the transmitting symbols;

a transmitting means for converting baseband signals to radio frequency signals to transmit the radio frequency signals to the radio station through the array antenna; and

a carrier separation means for separating the baseband signal received at the M pieces of antenna elements into N pieces of sub-carriers, where N is an integer of 2 or more,

wherein the carrier modulation signal is configured by multiple carriers, and said carrier separation means, after separating the received baseband signal into N pieces of sub-carriers, generates "M x N" pieces of receiving symbols that are estimate values of a complex propagation channel based on the reference symbol, where N is an integer of 2 or more.

3.-4. (Cancelled)

5. (Previously Presented) The transmitting apparatus according to claim 2, wherein

the M pieces of antenna elements configuring said array antenna have a mutually-different directional pattern, or mutually-different polarization.

6.-7. (Cancelled)

8. (Previously Presented) The transmitting apparatus according to claim 2, wherein

a transmitting symbol calculation means calculates plural sets of transmitting symbol vectors from the "M x N" pieces of receiving symbols for each of N pieces of sub-carriers so that each vector is configured by M pieces of transmitting symbols and then generating reference tables configured by the plural sets of transmitting symbols vector, a symbol mapping means generates "M x N" pieces of transmitting symbols by selecting one set of transmitting symbol vector from each of N pieces of reference tables that correspond to the N pieces of sub-carriers based on transmitting data and a single carrier modulation means generates transmitting baseband signals from "M x N" pieces of transmitting symbols with N pieces of sub-carrier elements.

9. (Previously Presented) A transmitting apparatus for transmitting data to a radio station, the apparatus comprising:

an array antenna including M, pieces of antenna elements for receiving a carrier modulation signal of a known symbol that is transmitting from a radio station and for transmitting a signal to the radio station, where M is an integer of 2 or more;

a reference symbol generation means for generating a reference symbol that gives a phase reference and is the same symbol with the known symbol;

a propagation channel estimation means for generating receiving symbols from a baseband signal received at the antenna elements based on the reference symbol, wherein the receiving symbols are estimate values for a complex propagation channel between a transmitting antenna of the radio station and the array antenna,

wherein said propagation channel estimation means, after applying a reverse spread separation process to the baseband signal received at the M pieces of antenna elements with N pieces of spread codes, generates "M x N" pieces of receiving symbols that are estimate values of a complex propagation channel based on the reference symbol, where N is an integer of 2 or more;

a transmitting symbol calculation means for calculating plural sets of transmitting symbol vectors from the receiving symbols so that each transmitting symbol vector is configured by plural sets of transmitting symbols and then generating a reference table configured by the plural sets of transmitting symbol vectors,

wherein the transmitting symbol calculation means calculates plural sets of transmitting symbol vectors from "M x N" pieces of receiving symbols for each of N pieces of spread codes so that each transmitting symbol vector is configured by M pieces of transmitting symbols and then generating reference tables configured by the plural sets of transmitting symbol vectors;

a symbol mapping means for generating transmitting symbols by selecting one set of the transmitting symbol vector from the reference table based on

transmitting data,

wherein the symbol mapping means generates "M x N" pieces of transmitting symbols by selecting one set of transmitting symbol vector from each of the N pieces of reference tables that correspond to the N pieces of spread codes respectively, based on transmitting data including confidential information;

a carrier modulation means for generating baseband signals from the transmitting symbols,

wherein the carrier modulation means generates transmitting baseband signals from the "M x N" pieces of transmitting symbols by spread process with N pieces of reverse spread codes; and

a transmitting means for converting baseband signals to radio frequency signals to transmit the radio frequency signals to the radio station through the array antenna.

10. (Cancelled)

11. (Previously Presented) The transmitting apparatus according to claim 8, wherein:

said transmitting symbol calculation means generates the plural sets of symbol vectors in order to control any one of receiving power and phase of the radio station.

12. (Previously Presented) The transmitting apparatus according to claim 9, wherein:

said transmitting symbol calculation means generates the plural sets of symbol vectors in order to control any one of receiving power/phase of the radio station.

13.-22. (Cancelled)

23. (Previously Presented) A radio communication method of transmitting data on a single carrier from a first radio station to a second radio station, comprising

the steps of:

transmitting information known by both radio stations from the second radio station to the first radio station;

estimating a propagation parameter, which is a parameter of a propagation channel shared only between the first radio station and the second radio station, based on the known information and received information transmitted from the second radio station by the first radio station;

transmitting data from the first radio station to the second radio station by superimposing the transmitting data including a confidential information on the estimated propagation parameter;

calculating a plurality of propagation parameters that are obtained from receiving signals of a plurality of antennas in the second radio station; and

reconstructing the transmitting data based on a plurality of propagation parameters calculated by the second radio station, wherein

said step of estimating a propagation parameter includes the steps of

generating a receiving symbol from the information transmitted from the second radio station, and

calculating plural sets of transmitting symbol vectors from the receiving symbols so that each transmitting symbol vector is configured by plural sets of transmitting symbols and then generating a reference table configured by the plural sets of transmitting symbol vectors, wherein the plural sets of transmitting symbol vectors is for controlling any one of receiving power and phase of the radio station.

24. (Previously Presented) A radio communication method of transmitting data on a multiple carriers from a first radio station to a second radio station, comprising the steps of:

transmitting information known by both radio stations from the second radio station to the first radio station;

estimating a propagation parameter, which is a parameter of a propagation channel shared only between the first radio station and the second radio stations, based on the known information and received information transmitted from the second radio station by the first radio station;

transmitting data from the first radio station to the second radio station by superimposing the transmitting data on the estimated propagation parameter;

calculating a plurality of propagation parameters obtained from receiving signals of a plurality of antennas in the second radio station; and

reconstructing the transmitting data based on the a plurality of propagation parameters calculated in the second radio station,

wherein said step of estimating a propagation parameter includes the steps of generating a receiving symbol from the information transmitted from the second radio station, and

calculating plural sets of transmitting symbol vectors from the receiving symbols so that each transmitting symbol vector is configured by plural sets of transmitting symbols and then generating a reference table configured by the plural sets of transmitting symbol vectors, wherein the plural sets of transmitting symbol vectors is for controlling any one of receiving power and phase of the radio station.

25. (Previously Presented) The radio communication method according to claim 24, wherein

the second radio station reconstructs the transmitting data based on the propagation parameter estimated from the receiving signal for each carrier configuring the multiple carriers.

26. (Previously Presented) The radio communication method according to claim 25, wherein

each carrier configuring the multiple carriers is any one of a OFDM signal that is so configured as to be mutually-orthogonal in a frequency space and a CDMA

signal that is so configured as to be mutually-orthogonal in a code space.

27. (Previously Presented) A radio communication system of transmitting data by a single carrier modulation method from a first radio station to a second radio station, comprising:

the first radio station comprising;

a propagation channel estimation means for estimating a propagation channel parameter including receiving symbols shared only between the first radio station and the second radio station, when the first radio station transmits data including confidential information to a second radio station;

a transmitting symbol calculation means for calculating plural sets of transmitting symbol vectors from the receiving symbols so that each transmitting symbol vector is configured by plural sets of transmitting symbols and then generating a reference table configured by the plural sets of transmitting symbol vectors, the plural sets of transmitting symbol vectors being for controlling any one of the receiving power and phase of the radio station; a symbol mapping means for generating transmitting symbols by selecting one set of the transmitting symbol vector from the reference table based on transmitting data; and

a transmitting means for generating a carrier modulation signal from the transmitting symbols and transmitting a signal including information of the transmitting data from the first radio station to the second radio station,

and

the second radio station comprising;

a propagation parameter estimation means for calculating a plurality of propagation parameters obtained from receiving signals of a plurality of antennas; and

a symbol determination means for reconstructing transmitting data from the first radio station based on a plurality of the calculated propagation parameters, wherein

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the data transmitting from the first radio station to the second radio station includes confidential information.